STATIONARY SUPERHEATERS

THE SUPERHEATER COMPANY

17 East 42nd Street, NEW YORK

PEOPLES GAS BUILDING
CHICAGO

UNION TRUST BUILDING
PITTSBURGH

BULLETIN T-15

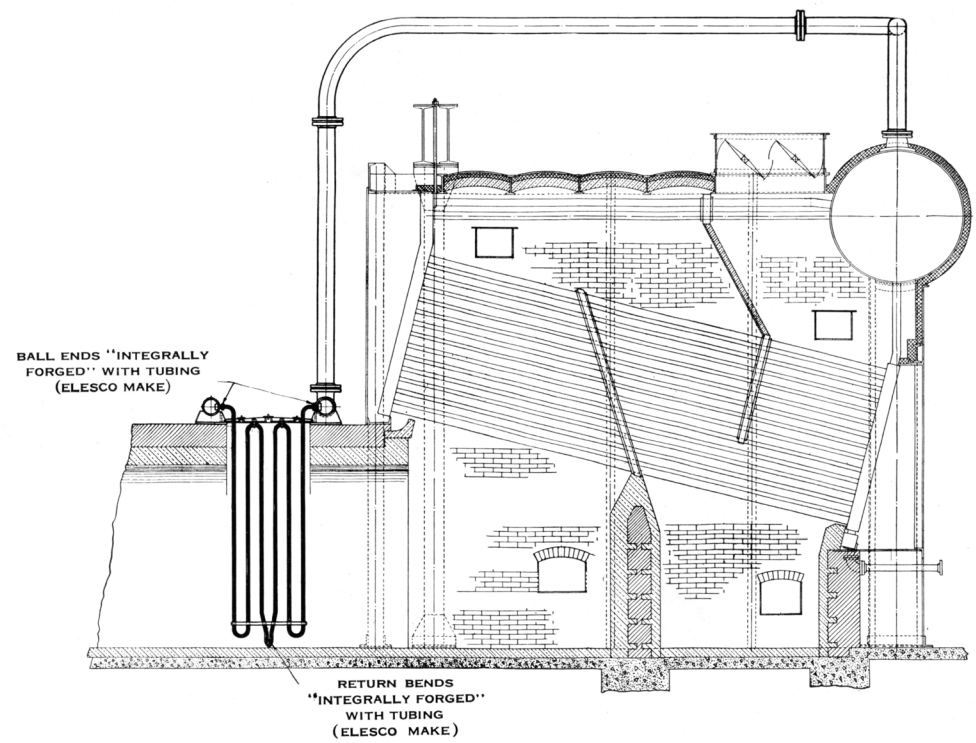

Fig. 1 Elesco Superheater in a Horizontal Cross Drum Waste Heat Boiler

ELESCO SUPERHEATERS FOR WASTE HEAT BOILERS

SPECIAL ADVANTAGES

1. Fewer joints to be kept steamtight.
2. Type of joint proven most efficient.
3. Headers and joints are outside of gas passage.
4. Uniform distribution of steam at all loads.
5. Highest heat transfer rate without objectionable cores.
6. Soot troubles and draft losses reduced to minimum.
7. Easy to install and inspect.
8. Only necessary to open small section of roof to install.
9. Designed by superheater experts to meet specific requirements.
10. Elesco, the standard of quality, is made by the world's largest manufacturer of superheaters.

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GENERAL DESCRIPTION

DESIGN

In waste heat boilers for cement mills utilizing waste gases from rotary kilns, and in boilers connected with open-hearth furnaces or in similar installations where the temperature of the waste heat gases is not above 1400 to 1500 deg., the superheater is located before the boiler or in the duct carrying the gases to the boiler. A comparatively small superheater is required in this location, due to the high temperature difference between the gases and the steam, so the pressure drop of the steam flowing through the units as well as the draft loss of the gases are relatively low.

Wherever possible, the superheater units are placed in the vertical position as shown in Figs. 1, 2 and 3. The headers and unit joints are located outside the setting which provides ready accessibility for inspection.

Where waste gases with temperatures higher than 1400 to 1500 deg. are available for the boiler, the superheaters are placed in the same location as in boilers having their own furnaces.

CONNECTING PIPE

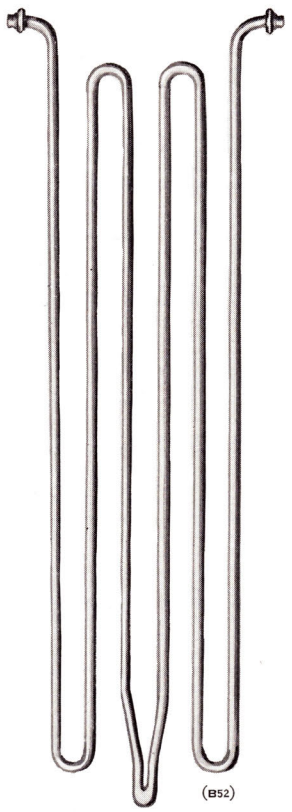
The connecting pipe is designed to insure dry steam from the boiler and is so proportioned as to cause the minimum pressure drop between the boiler and the superheater headers. It is of lapwelded or seamless steel pipe and Van Stoned with square corners, using forged steel flanges.

HEADERS

The headers and unit joints are located outside the boiler setting. They are made of extra strong or thicker open-hearth steel pipe; the wall thickness being dependent upon the pressure. They are round and without handholes. There is an inside bar reinforcement extending in sections the entire length of the headers, uniformly distributing the stresses of the superheater unit studs. The saturated steam inlet and the superheated steam outlet are always located at opposite sides of the setting. This arrangement insures uniform distribution of steam through the units at all boiler loads. The inlet and outlet ends are flanged for pipe connections. The superheated steam header is fitted with a safety valve and thermometer well. Both headers are equipped with drain valves and connections for pressure gages.

SUPERHEATER UNITS

Upon leaving the saturated steam header, the steam passes through a number of superheater units arranged as multiple loops in parallel. These units are of such shape as to cause the steam to travel several times back and forth through the hot gas zone, thus insuring uniformity of superheat.

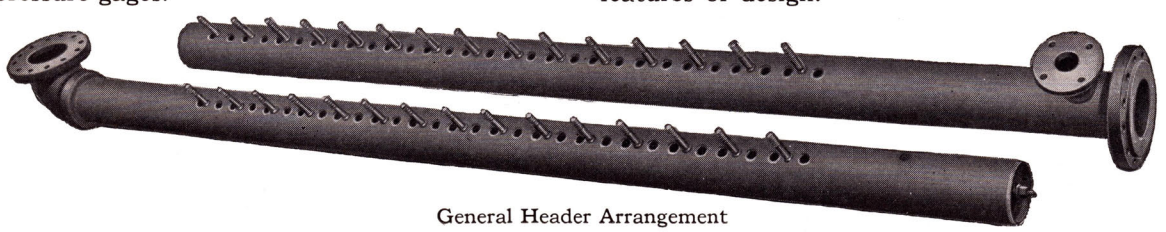


A Three-Loop Elesco Superheater Unit for Waste Heat Boilers

Elesco units are made of heavy gage, small diameter, seamless steel tubing, and have smooth inside and outside surfaces. There is no external roughness to catch soot. Elesco units, therefore, offer the least resistance to the flow of the gases. This is of considerable importance in connection with waste heat boilers where any draft loss should be avoided and where the gases frequently contain soot and ashes.

The inside cross-sectional area is uniform throughout, and is proportioned to give efficient velocity without resorting to cores. The form of the units is such as to permit free expansion and contraction of all parts.

Theoretically, the smaller the tube and the higher the velocity, the greater the rate of heat transfer. Practice has demonstrated that small diameter, seamless steel tubing, with the Elesco forged return bend, generally gives the most satisfactory results in the stationary field as to heat transfer, pressure drop and physical construction. The excellent rate of heat transfer attained in Elesco units is largely due to these features of design.



General Header Arrangement

FORGED RETURN BENDS

By means of Elesco forged return bends it is possible to make multiple-loop superheater units of any length, despite limitations in length of tubing obtainable from the mill, and

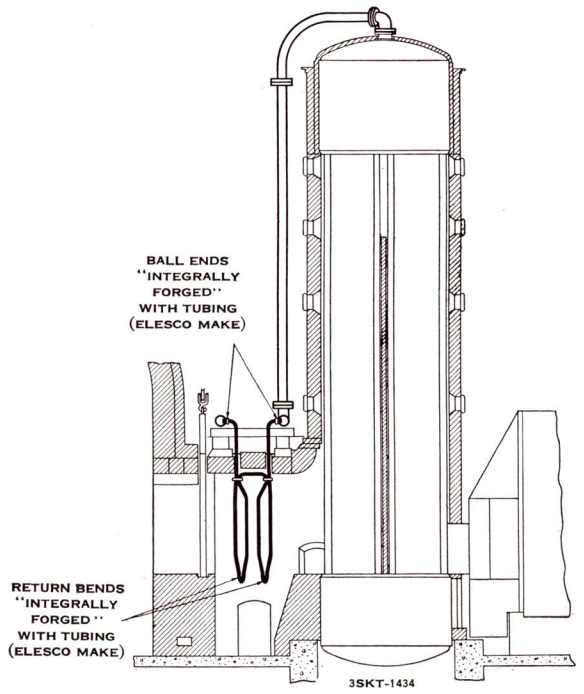
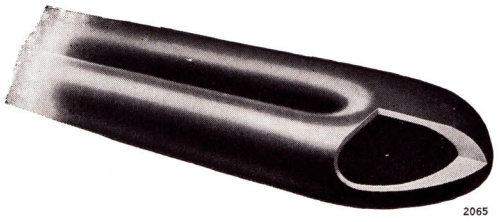


Fig. 2 Elesco Superheater in a Wickes Vertical Waste Heat Boiler

without locating joints of any kind in the path of extremely hot gases. With the multiple-loop arrangement, exclusive in Elesco superheaters, it is possible to obtain the desired superheat with a single-pass superheater comprising many units, all of the same length, except under exceptionally rare circumstances. Since different sizes of tubing can be used in the manufacture of



Elesco Forged Return Bend

Elesco units, these features give the superheater designer full control over the proportions of heating surface and steam area of the superheater—a very important matter in design.

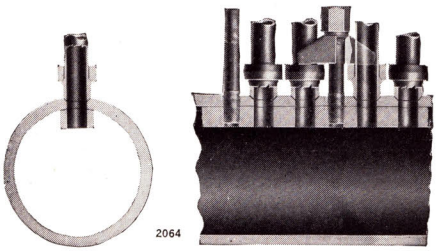
The sharp reversal of steam flow at the return bends breaks up the wet center core of steam, effectively prevents water from being carried through the superheater and avoids stratification of the steam flow, where any of these conditions exists, thus increasing the heat transfer and causing all particles of the steam to be superheated uniformly. There is no restriction of steam area at the bends, nor undue restriction of the gas flow area.

By means of a mechanical die-forging process two pieces of tubing are bonded together without the use of additional material or a flux; a true forged bond of metals is performed under ideal conditions.

Units so formed are homogeneous and as strong as the tubing of which they are made. In addition, the thickness of the metal is increased at the bend so that it is stronger than the straight tubing. Millions of these return bends are in daily use under the severest conditions.

BALL JOINTS

Elesco superheater units are attached to the headers by means of clamped metal-to-metal



Cross Section of Elesco Type Header Showing Clamping Method and Unit Ball Ends

ball joints; neither threaded, rolled nor autogeneously welded joints are used. This joint eliminates the necessity of handholes in the headers, and thus reduces the number of joints. In other designs of superheaters having the same heating surface, handholes in the headers may necessitate two to three times as many joints to be kept steamtight. The ball joint originally was designed for high-pressure work and is used also for conditions subject to severe vibration. It permits of quick and easy application or removal of units without special tools. It is flexible, remains tight under the severest operating conditions, and is easy to adjust and maintain.

To form ball-shaped ends on the superheater units, the ends of the units are first subjected to a special upsetting or forging process. After this operation the ends are faced in a lathe and ground to form true parts of a sphere so that they will fit into the 45-deg. conical seats in the header. These seats are so

ground that each ball end will have a line contact at the center of the 45-deg. face.

Both clamps and washers for the ball joints are made of steel. The clamp studs are made of special heat-treated alloy steel having a minimum tensile strength of 100,000 lb. per sq. in.

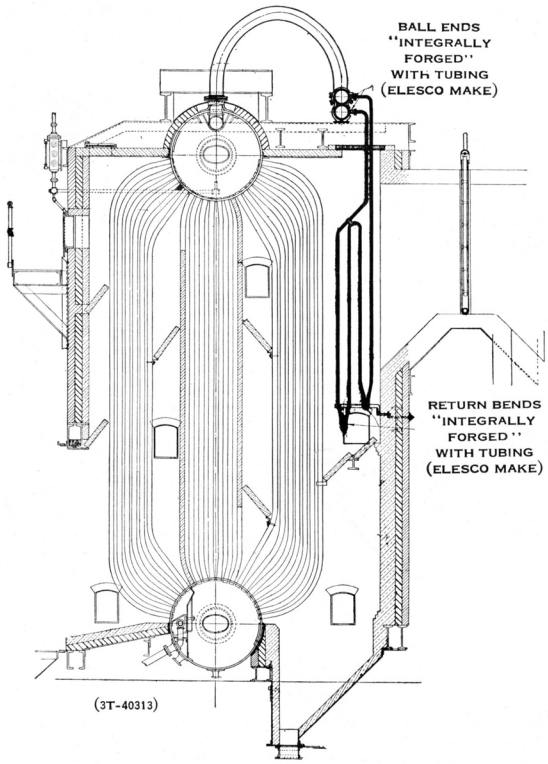


Fig. 3 Elesco Superheater in a Vertical Waste Heat Boiler

UNIT AND HEADER SUPPORTS

The units and headers are usually suspended from the steel work. The support is such as to permit free expansion of headers and units.

UNITS ENTER THROUGH THE ROOF

The brick roof is usually supported by cast-iron tee bars, any portion of which can be removed readily. The openings for units are sealed with asbestos rope and cement.

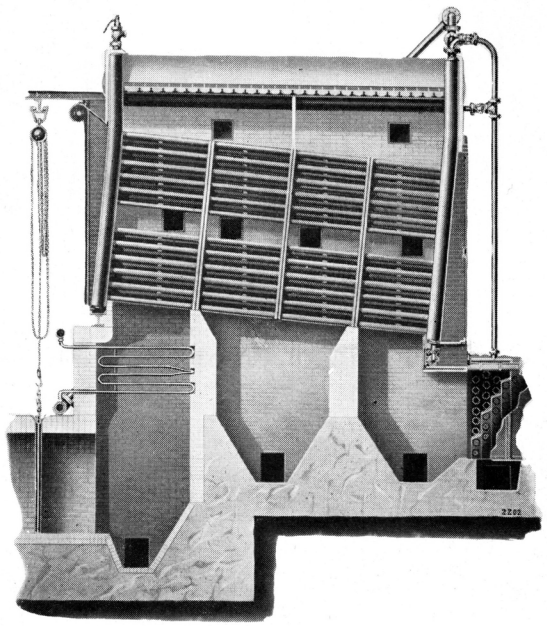


Fig. 4 Elesco Superheater in an Edge Moor Waste Heat Boiler

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